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RESPONSE OF SASKATCHEWAN BOREAL PLANT SPECIES TO ACIDIC DEPOSITION
RESULTS OF PRELIMINARY EXPERIMENTS

by

Lawrence Baschak

and

Zoheir Abouguendia

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1 BACKGROUND AND OBJECTIVES

The present levels of acidic deposition in northern Saskatchewan are generally low and considered to represent natural background levels. However, the projected annual sulphur emissions in the tar sand and Lloydminster areas will more than double by the year 2006 causing significant increase in the levels of acidic deposition (Shewchuk *et al* 1981).

Potential effects of acidic deposition on plants include reduction of photosynthesis and growth, premature senescence of leaves, chlorosis, necrosis of tissues, acceleration of nutrient leaching and increased susceptibility to other environmental stresses such as drought and disease. Reduction in forest growth in eastern U.S.A. and northern Europe has been attributed to the effect of acidic precipitation. A detailed review of these effects can be found elsewhere (Abouguendia and Godwin 1980; Abouguendia and Godwin 1981; Shewchuk *et al* 1981).

Several reports on the relative sensitivity of vascular plants to acidic deposition have appeared in the literature in recent years (e.g. Jacobson and van Leuken (1977); Lee and Weber (1979); Haines *et al* (1980); Shriner (1980)). However, most of these studies have dealt with European or Eastern North American species. None of the major northern Saskatchewan plants has been studied with regard to their sensitivity to acidic precipitation. The northern ecological regions of Saskatchewan have been judged to be sensitive to acidic precipitation and are likely to receive greater deposition rates than the southern areas.

The present report deals with the results of a preliminary laboratory investigation designed mainly to test the application of the simulated "acid rain" technique on two Saskatchewan forest species and to

observe and describe visible symptoms of injury induced by simulated acid rain application.

2 METHODOLOGY

Twig cuttings of two coniferous boreal plant species, jack pine (*Pinus banksiana*) and white spruce (*Picea glauca*) were obtained from the Parks and Recreation Department, City of Saskatoon. The lower portions of the cuttings were kept immersed in distilled water during the experimental period.

The simulated acid rain solutions consisted of distilled water amended with H_2SO_4 to the desired pH value. Initial experimentation with solutions having pH levels of 2 and 3 produced no visible damage symptoms. Therefore the pH 3 treatment was replaced with a stronger simulated acid rain solution of pH 1.

Each species was represented by five twig cuttings for each treatment with a complement of five control twigs.

Twigs were dipped into the simulated acid rain solutions as described by Heard (1980). Six applications were performed within seven days.

Plant needles were examined for the presence of chlorotic and/or necrotic spots and then the extent of visible injury was evaluated.

3 RESULTS AND DISCUSSION

The pH 1 treatment produced visible injury to the needles of both species tested (Table 1). Severe chlorosis was observed on jack pine while white spruce showed some signs of chlorosis and necrosis. Similar results were reported for another pine species by Heard (1980). Needles of eastern white pine (*Pinus strobus*) exhibited damage at pH values between 1.0 and 0.5. Information on susceptibility of white spruce to acid rain are lacking.

Table 1. Number of Needles Showing Visible Injury.

Species	pH	Final Counts
Jack pine (*Pinus banksiana*)	1	all needles affected
	2	no visible damage detected
White spruce (*Picea glauca*)	1	14*
	2	7

*Total number of needles - ≈ 3,000 plus in five replicates.

The pH 2 treatment had no visible effect on jack pine while some chlorotic spots were evident on white spruce needles.

Chlorosis appeared to occur where water collected on leaf surfaces, i.e. undersides of white spruce needles and the tips and undersides of jack pine needles. Jack pine appears to retain more solution on leaf surfaces and for a longer period of time than white spruce. This may explain why jack pine was affected more severely at pH 1 than white spruce (Table 1).

Needles showing injury were examined to compare the extent of chlorosis in the two species. The extent of damage (chlorosis and/or necrosis) was evaluated in relation to the total length of the needles (1/4, 1/2, 3/4 or full length).

In the case of jack pine, pH 1 resulted in chlorosis extending to nearly half the total needle length. The same pH level resulted in a few necrotic spots and chlorosis covering 1/4 to 1/2 of white spruce needles.

pH 2 resulted in one or two chlorotic spots per affected needle in the case of white spruce, while no visible injury was observed on jack pine as already indicated.

4 CONCLUSIONS

(1) The results of the preliminary study indicated that the threshold for visible injury from short term simulated acid rain application is between pH 1 and 2 for jack pine and pH 2 or above for white spruce. These levels are comparable to those reported in the literature for other coniferous species.

(2) Differences in the severity (extent) of injury between the two species tested appear to be related to surface moisture retention characteristics of the needles.

(3) Further studies are required for more comprehensive laboratory and field assessment of the major forest species. Future studies should simulate the chemical composition of rain in the forested areas of the province instead of using distilled water. Also, seedlings or young trees should be used. The recommended studies should determine whether growth effects occur at pH levels higher than the threshold for visible injury. Therefore, other parameters, such as chlorophyll content of leaves, should be considered.

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Saskatchewan Research Council
30 Campus Drive
Saskatoon, Saskatchewan
Canada
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